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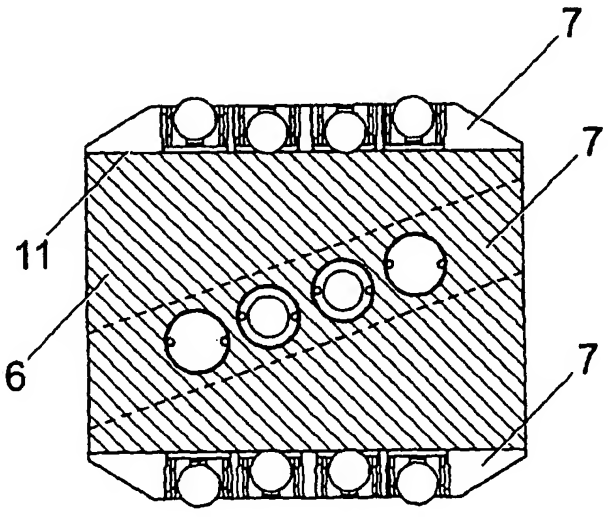

(57) Abstract: A centraliser (1) has a substantially annular body (6), a substantially cylindrical bore extending longitudinally through the body (6), and at least one roller ball (29). The roller ball (29) is preferably secured to the centraliser (1) in a manner which enables the roller ball (29) to rotate in all directions with respect to the centraliser (1), and one roller ball (29) is secured within at least one aperture (9; 109) provided in the sidewall of the body (6). Preferably, an assembly (27, 28, 39; 127, 128, 139) is provided to house the roller ball (29) within the at least one aperture (9; 109), and the roller ball (29) may be arranged to project either outwardly or inwardly from the sidewall.

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"Centraliser"

The present invention relates to a centraliser, typically for use with a casing string, a liner/tubing string or a drill string, which is inserted into a borehole.

Conventionally, when a well has been drilled for the eventual production of hydrocarbons, one of the procedures commonly employed in readying the well for production comprises installing hollow tubular casing (otherwise known as "a casing string") in the uppermost section of the well to line the borehole. The space (otherwise known as the "annulus") between the exterior of the casing string and inner surface of the borehole is filled with cement which acts as a sealant and provides mechanical support for the casing string. Thereafter, and as is usually required, a smaller diameter tubular string (otherwise known as a "liner string" or "tubing string") is inserted through the casing string in order to line the lower sections of the borehole.

Since it is desirable that the casing or liner/tubing string be centralised in the wellbore when cemented, it is known to externally mount centralisers on the casing or liner/tubing string to hold the string away from the wellbore; i.e. toward the centre of the borehole.

However, particularly with very deep and/or extended reach wells, which may be in the region of many thousands of feet in length, it is desirable, and in many cases thought essential, to reduce the friction between the exterior of the centralisers and the inner surface of the borehole, such that the casing or liner/tubing string can more easily be run into the wellbore.

According to a first aspect of the present invention, there is provided a centraliser comprising a substantially annular body, a substantially cylindrical bore extending longitudinally through the body, the annular body comprising at least one roller ball.

According to a second aspect of the present invention, there is provided a method of running a string of tubulars into a well bore, the method comprising providing a centraliser comprising a substantially annular body, and a substantially cylindrical bore extending longitudinally through the body, and the annular body comprising at least one roller ball.

Typically, the centraliser is arranged around a string of tubulars, such that the string of tubulars passes through the substantially cylindrical bore. The string of tubulars may be a casing string, a liner/tubing string or a drill string, and the centraliser is preferably adapted to centralise the string of tubulars within either another string of tubulars such as a casing string or a liner/tubing string or within an open hole.

Preferably, the roller ball is secured to the centraliser in a manner which enables the roller ball to rotate with respect to the centraliser.

Typically, the centraliser is provided with at least one aperture, and the roller ball is secured within the aperture, preferably by means of screw threads. The aperture is preferably formed in a sidewall of the centraliser, and more preferably, the aperture is formed in a blade of the centraliser, where the blade typically extends outwardly from the annular body. Typically, a number of blades may be provided.

The aperture is preferably arranged wholly through the sidewall, and the aperture is preferably arranged such that the roller ball may be arranged to project outwardly from the sidewall and/or may be arranged to project inwardly from the sidewall. Preferably, an assembly is provided to house the roller ball within the aperture, and the aperture is

provided with a shoulder which can bear against a portion of the assembly.

Typically, if the roller ball is arranged to project outwardly from the sidewall, then the shoulder bears against at least a portion of a face of the assembly and if the roller ball is arranged to project inwardly from the sidewall then the shoulder bears against at least a portion of a face of the assembly.

Typically, if the roller ball is arranged to project outwardly from the sidewall, then the shoulder bears against at least a portion of an inner most face of the assembly and if the roller ball is arranged to project inwardly from the sidewall then the shoulder bears against at least an portion of an inner most face of the assembly.

Typically, if the roller ball is arranged to project outwardly from the sidewall, then the shoulder bears against at least a portion of a face of the assembly that is farthest away from the projecting surface of the roller ball and if the roller ball is arranged to project inwardly from the sidewall then the shoulder bears against at least an portion of a face of the assembly that is closest to the projecting surface of the roller ball.

Preferably, a number of apertures may be provided, such apertures typically being spaced apart in the longitudinal direction of the body and which may be

circumferentially spaced apart. Typically, the centraliser comprises a plurality of blades.

Typically, if the roller ball is arranged to project outwardly from the sidewall, it is capable of making contact with the inner surface of a string of tubulars or a bore of an open hole. Typically, if the roller ball is arranged to project inwardly from the sidewall, it is capable of making contact with the string of tubulars passing through the substantially cylindrical bore of the centraliser.

Preferably, the roller ball is an omnidirectional roller ball.

The centraliser may be free to rotate with respect to the string of tubulars passing through the substantially cylindrical bore of the centraliser. The centraliser may be free to move along the longitudinal axis of the string of tubulars passing through the substantially cylindrical bore of the centraliser, although the centraliser may be restricted in such axial movement by any suitable means, such as stop collars and the like.

Alternatively, the centraliser may be locked with respect to the string of tubulars passing through the substantially cylindrical bore of the centraliser by any suitable means such as grub screws and the like.

According to a third aspect of the present invention, there is provided a roller ball assembly for use with a centraliser, the roller ball assembly comprising a roller ball and a housing for the roller ball, the housing comprising an engagement means capable of engaging with an engagement means of the centraliser.

Preferably, the roller ball assembly of the third aspect is incorporated in a centraliser of the first and/or second aspects of the invention.

The housing of the roller ball assembly preferably comprises an inner surface which substantially corresponds to the shape of the roller ball, and an aperture to permit a portion of the roller ball to project outwardly therefrom. Typically, the housing further comprises a seal to prevent ingress of debris from outside of the housing into the interior of the housing, in use. The housing is preferably provided in at least two parts to permit the insertion of the roller ball into the housing, and may be provided with locking means (which are preferably dis-engageable) to prevent movement between the said parts of the housing.

Typically, the engagement means comprises screw threads. Preferably, the screw threads of the roller ball assembly are provided on an outer surface of the housing.

A recess or chamber may be provided, typically within the housing, into which a fluid is placed, the fluid providing lubrication between the roller ball and the housing.

The at least two parts of the housing are preferably secured to one another by applying a compression force thereto.

The roller ball assembly may be removed from engagement with the centraliser for any desired purpose, such as redressing or refurbishment, or to change the configuration of the roller ball assembly.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a cross-sectional plan view of a liner/tubing string with a centraliser in accordance with the roller ball assemblies in accordance with the present invention externally mounted thereon, being run into an already cased borehole;

Fig. 2 is a cross-sectional side view of the centraliser of Fig. 1 in isolation;

Fig. 3 is a plan side view of the centraliser of Fig. 1 in isolation;

Fig. 4 is a cross-sectional plan view through an aperture formed in a blade of the centraliser of Fig. 1;

Fig. 5 is an exploded side view of a first embodiment of a roller ball assembly for insertion into the aperture of Fig. 4;

Fig. 6 is a cross-sectional side view of a blade (having apertures with roller ball assemblies of Fig. 5 mounted therein) of the centraliser of Fig. 1;

Fig. 7 is a cross-sectional side view of a blade (having apertures therein) of the centraliser of Fig. 1;

Fig. 8 is a cross-sectional side view of a second embodiment of a roller ball assembly within an aperture formed in a blade of the centraliser of Fig. 1;

Fig. 9 is a cross-sectional view of the complete roller ball assembly of Fig. 8 in isolation;

Fig. 10 is a top plan view of the complete roller ball assembly of Fig. 9;

Fig. 11 is an exploded side view of the roller ball assembly of Fig. 9;

Fig. 12 is a cross-sectional view of the ball retainer of the roller ball assembly of Fig. 9;

Fig. 13 is a cross-sectional view of the ball mount of the roller ball assembly of Fig. 9; and

Fig. 14 is a bottom plan view of the ball mount of the roller ball assembly of Fig. 9.

Fig. 1 shows a centraliser 1 being mounted on the exterior of a liner/tubing string 3, where the liner/tubing string 3 (and hence the centraliser 1)

are run into a borehole through an upper section of casing 5 which has already been cemented into the borehole. As is conventionally known, the upper end of the tubing string 3 is run into the borehole until it approximately reaches the lower end of the casing string 5, and at this point the upper end of the tubing string 3 will be hung off on the lower end of the casing string 5. Thereafter, additional cement will conventionally be pumped down the interior of the casing string 5 and hence interior of the tubing string 3 until it settles in the annulus between the exterior of the tubing string 3 and the interior of the borehole.

However, it should be noted that the centraliser 1 of the present invention is not limited to such use, and can also be used in running-in casing strings 5 and can also mounted on the exterior of drill strings (not shown). Additionally, the centraliser 1 can also be used to run in other tubulars (not shown) required downhole, such as screens, for example sand screens, and other tubing.

As is also conventional, the centraliser 1 can either be rotationally and longitudinally locked to the liner string 3 by any conventional means, such as grub screws (not shown). Alternatively, the centraliser 1 can be preferably be allowed to "free float" along a distinct and predetermined axial length of the tubing string 3 between a pair of stop collars which are mounted on the exterior of the tubing string 3 a set distance apart, such as 10

feet for example. The pair of stop collars deny the centraliser 1 the opportunity to travel past either the upper or the lower stop collar.

The centraliser 1, as shown more clearly in Fig. 2, comprises a generally cylindrical and annular body 6 upon which is mounted a plurality of outwardly extending blades 7. In a preferred embodiment, there are four blades 7 provided, but it should be noted that any suitable number of blades 7 could be provided. As also shown in Figs. 2 and 3, each of the blades 7 not only extends between longitudinally opposite ends of the body 6, but also extends circumferentially part-way around the periphery of the body 6 of the centraliser 1. The skewing of the blades 7 amongst other advantages, means that their respective radially outer edges 8 collectively provide a circumferentially substantially uniform wellbore-contacting surface with the centraliser 1.

The blades 7 are preferably fabricated integrally with the body 6, such that the centraliser 1 is a one-piece article, and may be formed from a suitable metal, alloy or plastic or the like. Alternatively, the blades 7 could be separately formed and subsequently attached to the body 6 by any suitable means, such as welding.

As shown more clearly on Figs. 4 and 7, each blade 7 is provided with a plurality of apertures 9 therein, and in the embodiment shown in the Figs. there are preferably four apertures 9 provided in each blade

7. As can be seen in Fig. 4, the central line 10 of each aperture 9 is concentric with the central line 10 of the outwardly extending blade 7, and hence the central line 10 of the aperture 9 is parallel with the axis on which the blade 7 outwardly extends.

The aperture 9 is preferably circular about its central line 10, and comprises an inner portion 12, a middle portion 14 and an outer portion 16. The middle portion 14 is cylindrical in shape, and comprises an axial length (along the central line 10) which is the majority of the axial length of the blade 7. The middle portion 14 comprises a screw thread 18 on its inner bore, and which is suitable for engagement with a housing of a roller ball insert 25 (which will be described in more detail subsequently). The junction between the middle portion 14 and the inner portion 12 comprises a shoulder 13 which extends inwardly from the diameter of the middle 14 to the inner 12 portions. The shoulder 13 is typically perpendicular to the central line 10 of the aperture 9. The inner portion 12 extends from the shoulder 13 through to the inner bore 11 of the body 6. Thus, the inner diameter of the inner portion 11 is smaller than the inner diameter of the middle portion 14.

The outer end of the outer portion 16 is of a greater diameter than the diameter of the inner end of the outer portion 16, such that the outer portion 16 has a frusto-conical shape, and this provides the advantage that the roller ball insert 25 (as will be

subsequently discussed) can more easily be inserted into the aperture 9 (as will also be subsequently discussed in more detail).

A first embodiment of a roller ball insert 25 is shown in exploded form in Fig. 5 and comprises a ball retainer 27, a ball seal 28, a ball 29, a ball seat housing 30 and keeper pins 31. The ball retainer 27 comprises a body 35 having a cylindrical outer surface at its lower end and an outwardly extending annular ring 36 provided at its upper end. The lower half of the inner surface of the body 35 is substantially cylindrical, and the upper half of the inner surface of the body 35 curves inwardly from the junction with the lower half, such that the upper half of the inner surface of the body 35 has a radius which substantially matches the radius of the ball 29. A cylindrical recess 37 is provided on the inner surface of the upper end of the body 35, and a ball seal 28 is inserted into the recess of 37. A pair of cylindrical bores 38A are drilled through the annular ring 36, such that a semi-circular groove in line with the bores 38A is provided on the outer surface of the body 35. The pair of bores 38A are diametrically opposed to one another.

The ball seat housing 30 comprises a screwthread 40 provided on its outer surface, such that the screwthread 40 is arranged to correspond with the screwthread 18 provided in the aperture 9. A pair of bores 38B are drilled through the housing 30, such that the pair of bores 38B are diametrically

opposite one another, and such that the pair of bores 38B are parallel with the longitudinal axis of the housing 30. The housing 30 comprises an upper half 30A and a lower half 30B. The axial extent of the upper half 30A substantially equals the axial extent of the cylindrical outer surface of the body 35, such that when the body 35 is inserted into the housing 30, the lower end of the body 35 rests upon shoulder 42 of the housing 30, and the lower face of the annular ring 36 rests upon the upper end of the ball seat housing 30. The lower half 30B has a substantially semi-circular groove 44 formed therein and which has a radius which substantially matches the radius of the ball 29. A rectangular recess 46 is provided at the lower end of the semi-circular recess 44, and grease, oil or other friction reducing fluids can be placed into recess 46 such that the ball 29 picks up said friction reducing fluids and is coated therewith.

The roller ball insert 25 is constructed as follows. The ball 29 is placed into the ball seat 30, such that it rests in the semi-circular recess 44. The ball seal 28 is inserted into the recess 37 of the ball retainer 27, and the ball retainer 27 is pressed into the ball seat housing 30, such that the bores 38A are aligned with the bores 38B. A keeper pin 31 is then inserted by suitable means, such as hammering, into the conjoined bore 38, such that the ball retainer 27 is restrained from rotating with respect to the ball seat housing 30. The ball retainer 27 is compression pressed with great force

into the ball seat housing 30 such that a friction fit is provided therebetween, and hence there is minimal risk of the ball retainer 27 from being ejected from the ball seat housing 30. In this manner, the ball 29 is held captive in the roller ball insert 25, but can rotate in all directions with respect thereto.

Hence, an omnidirectional roller ball insert 25 is provided.

As shown in Figs. 2, 3 and 6, roller ball inserts 25 are screwed into the apertures 9. However, as can also be seen from the Figs., the roller ball inserts 25 may be provided in the apertures in two different configurations, these being:-

a) the roller ball 29 projecting through the ball seal 28 in an outwardly direction from the blades 7; and

b) the roller ball 29 projecting through the ball seal 28 inwardly into the body 6 from the blades 7.

The apertures 9 are arranged such that they can accommodate either configuration a) or b) of the roller ball insert 25. With regard to configuration a), the seat 13 of the aperture 9 provides a stop for the lower (with regard to Fig. 5) face of the ball seat housing 30, and the dimensions of the aperture 9 and the lower roller ball insert 25 are

such that the roller ball 29 will project outwardly from the face of the roller ball insert 25, and hence the blades 7.

With regard to configuration b), the shoulder 13 provides a stop for the outer (and upper with regard to Fig. 5) face of the annular ring 36, such that the roller ball 29 projects inwardly into the bore 11 of the body 6.

In use, an operator can choose the configuration of the roller ball inserts 25 between configurations a) and b) as desired. For instance, an operator may wish to have all of the roller ball inserts 25 in a particular centraliser 1 arranged in configuration a). Alternatively, an operator may desire to have all of the roller ball inserts 25 of the centraliser 1 arranged in configuration b). Alternatively, an operator may wish to have a combination of configurations a) and b) of the roller ball inserts 25 for a particular centraliser 1, and this latter option is shown in Figs. 1, 2, 3 and 6. Further alternatively, an operator may, if desired, wish to blank off one or more apertures with a suitable plug (not shown). The embodiment provides the advantage that roller ball inserts 25 arranged in configuration b) will engage the outer surface of tubing string 3, thus minimising friction between the centraliser 1 and the tubing string 3. In this manner, the tubing string 3 can rotate with respect to the centraliser 1 with minimal friction therebetween.

A second embodiment of a roller ball insert 125 is shown in exploded form in Fig. 11 and comprises a ball retainer 127, a ball seal 128, a ball 29, and a ball mount or seat housing 130. The ball retainer 127 comprises a body 135 having a screwthread 140 provided on its outer surface, such that the screwthread 140 is arranged to correspond with the screwthread 118 provided in the aperture 109. The ball retainer 127 comprises an upper half 135A and a lower half 135B. The axial extent of the upper half 135A substantially equals the axial extent of the cylindrical outer surface of the ball mount 130, such that when the ball mount 130 is inserted into the ball retainer 127, the upper end of the ball mount 130 rests upon shoulder 142 of the ball retainer 127. The ball mount 130 has a substantially semi-circular groove 144 formed therein and which has a radius which substantially matches the radius of the ball 29. A rectangular recess 146 is provided at the lower end of the semi-circular recess 144, and grease, oil or other friction reducing fluids can be placed into recess 146 such that the ball 29 picks up said friction reducing fluids and is coated therewith. In addition, or alternatively, as shown in the Figs., a small aperture 150 is formed on the centre line of the ball mount 130, such that the small aperture 150 is aligned, in use, with fluid access aperture 155 formed on the centre line of the aperture 109 in the blade 107, such that the ball 29 is lubricated by downhole fluid through the apertures 155 and 150.

The lower half 135B of the inner surface of the ball retainer 127 is substantially cylindrical, and the upper half 135B of the inner surface of the ball retainer 127 curves inwardly from the junction with the lower half 135B, such that the upper half 135A has a radius which substantially matches the radius of the ball 29. A cylindrical recess 137 is provided on the inner surface of the upper end 135A, and a ball seal 128 is inserted into the recess 137.

The roller ball insert 125 is constructed as follows. The ball 29 is placed into the ball mount 130, such that it rests in the semi-circular recess 144. The ball seal 128 is inserted into the recess 137 of the ball retainer 127, and the ball mount 130 and ball 29 are pressed into the ball retainer. The ball mount 130 is compression pressed with great force into the ball retainer 127 such that a friction fit is provided therebetween, and hence there is minimal risk of the ball mount 130 from being ejected from the ball retainer 127. In this manner, the ball 29 is held captive in the roller ball insert 125, but can rotate in all directions with respect thereto.

Hence, a second embodiment of omnidirectional roller ball insert 125 is provided.

It should be noted that the aperture 109 is intended for use with the roller ball insert 125 in the configuration shown in Fig. 8; that is in

configuration a) as described above. The reader will understand that the aperture 109 can be modified or formed more akin to the aperture 9 if configuration b) is desired.

Furthermore, with the roller ball inserts 25 arranged in configuration a), the centraliser 1 can rotate with respect to the inner surface of the casing string 5, with minimal friction therebetween.

However, as previously described, an operator can, if desired, lock the centraliser 1 to the tubing string 3 by any suitable means, such as grub screws, and also can provide a pair of stop collars at a suitable distance apart, and can located a centraliser 1 in between the pair of stop collars, such that the centraliser 1 has a restricted longitudinal and axial travel along the liner tubing string 3, this travel being restricted to the distance that the stop collars are set apart.

Furthermore, the provision of roller balls 29 in the centraliser 1 provides the advantage over axially arranged rollers that the roller balls 29 are omnidirectional, whereas axial rollers are limited to only acting in one direction.

The embodiments also have the advantage that the weight acting between the tubing string 3 and the casing string 5 or open hole is spread over a relatively high plurality of roller balls 29.

The roller ball 29 can be formed from any suitable materials, such as stainless steel, and the roller ball inserts are preferably formed from a suitable material such as an alloy, and which may be brass.

Modifications and improvements may be made to the embodiment with departing from the scope of the invention.

CLAIMS:-

1. A centraliser comprising a substantially annular body, a substantially cylindrical bore extending longitudinally through the body, the annular body comprising at least one roller ball.

2. A centraliser according to claim 1, wherein the roller ball is secured to the centraliser in a manner which enables the roller ball to rotate in all directions with respect to the centraliser.

3. A centraliser according to either of claims 1 or 2, wherein the centraliser is provided with at least one aperture, and the roller ball is secured within the aperture.

4. A centraliser according to claim 3, wherein the at least one aperture is formed in a sidewall of the centraliser.

5. A centraliser according to claim 4, wherein the at least one aperture is formed in a blade of the centraliser.

6. A centraliser according to any of claims 3 to 5, wherein the at least one aperture is arranged wholly through the sidewall.

7. A centraliser according to any of claims 3 to

6, wherein at least one of the apertures is arranged such that the roller ball is arranged to project outwardly from the sidewall.

8. A centraliser according to any of claims 3 to 7, wherein at least one of the apertures is arranged such that the roller ball is arranged to project inwardly from the sidewall.

9. A centraliser according to any of claims 3 to 8, wherein an assembly is provided to house the roller ball within the at least one aperture.

10. A centraliser according to any of claims 3 to 9, wherein the at least one aperture is provided with a shoulder which is adapted, in use, to bear against a portion of the assembly.

11. A centraliser according to any of claims 3 to 10, wherein a plurality of apertures are provided, such apertures being spaced apart in the longitudinal direction of the body.

12. A method of running a string of tubulars into a well bore, the method comprising providing a centraliser comprising a substantially annular body, and a substantially cylindrical bore extending longitudinally through the body, and the annular body comprising at least one roller ball.

13. A roller ball assembly for use with a centraliser having an engagement mechanism, the

roller ball assembly comprising a roller ball and a housing for the roller ball, the housing comprising an engagement mechanism capable of engagement with the engagement mechanism of the centraliser.

14. A roller ball assembly according to claim 13, wherein the housing comprises an inner surface which substantially corresponds to the shape of the roller ball, and an aperture to permit a portion of the roller ball to project outwardly therefrom.

15. A roller ball assembly according to claim 14, wherein the housing further comprises a seal to prevent ingress of debris from outside of the housing into the interior of the housing, in use.

16. A roller ball assembly according to any of claims claim 13 to 15, wherein the housing is provided in at least two parts to permit the insertion of the roller ball into the housing.

17. A roller ball assembly according to any of claims 13 to 16, wherein the engagement mechanisms comprise screw threads.

18. A roller ball assembly according to claim 17, wherein the screw threads of the roller ball assembly are provided on an outer surface of the housing.

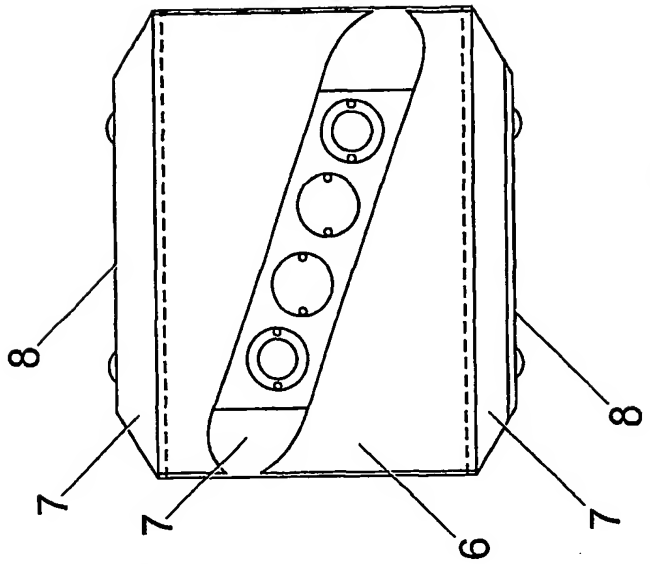

Fig. 3

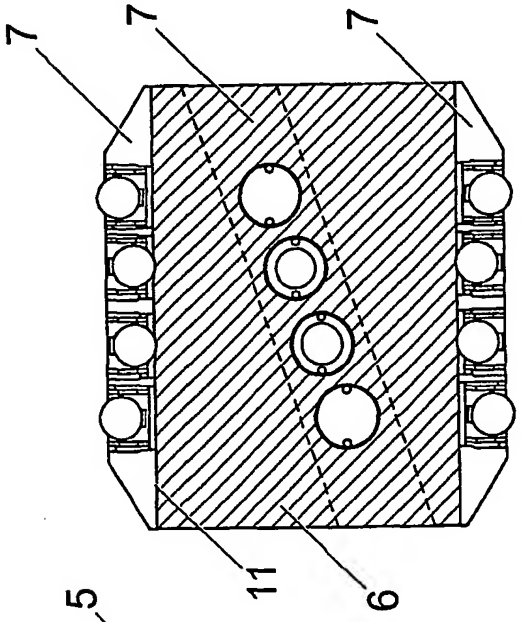

Fig. 2

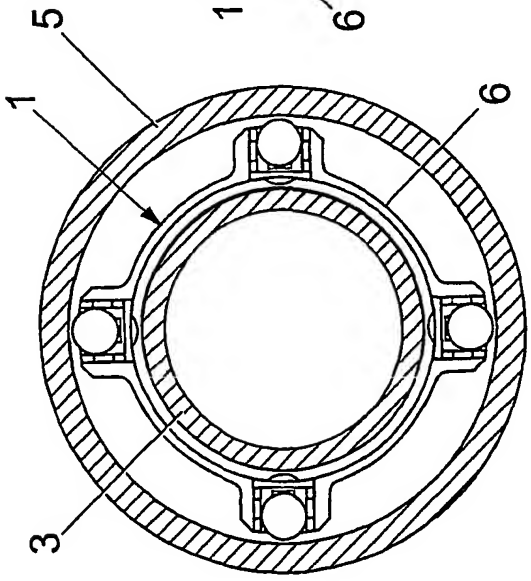

Fig. 1

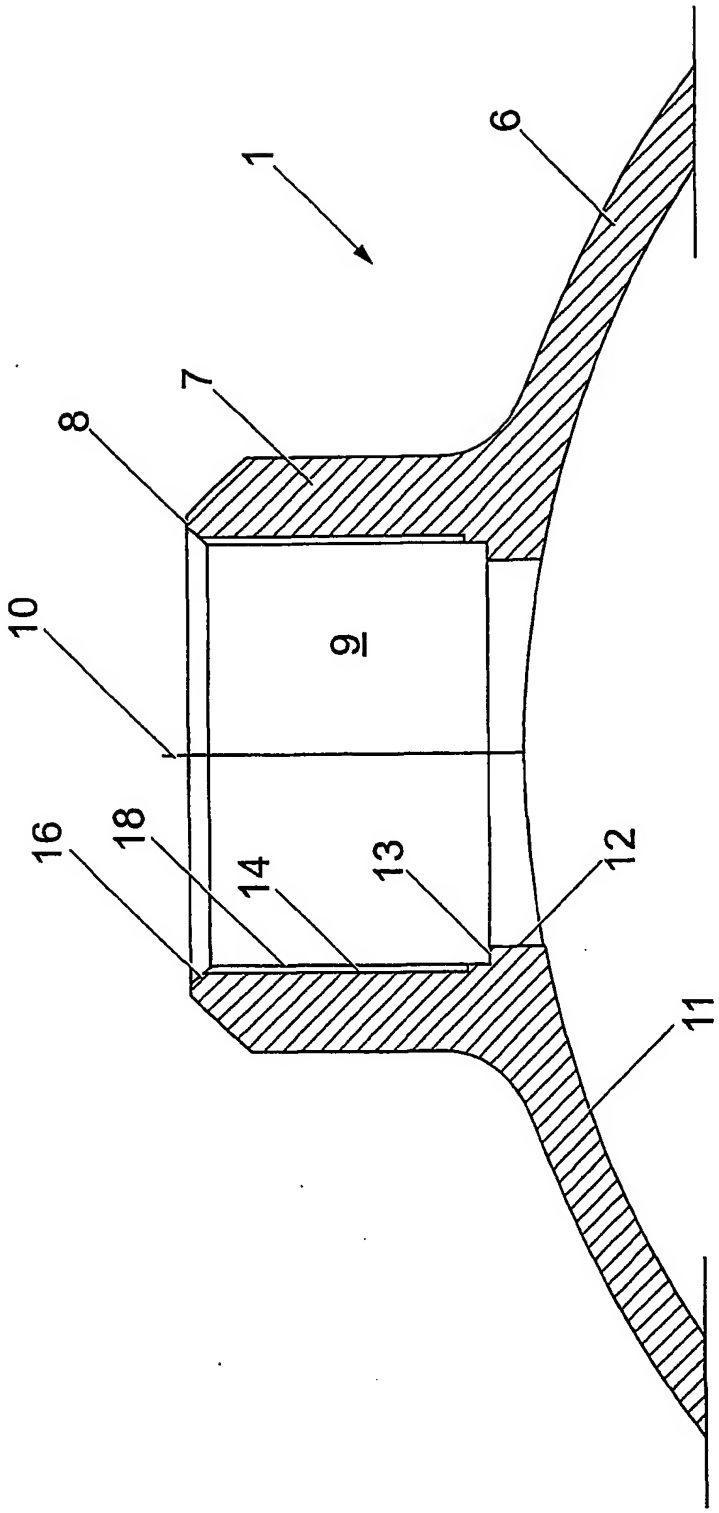

Fig. 4

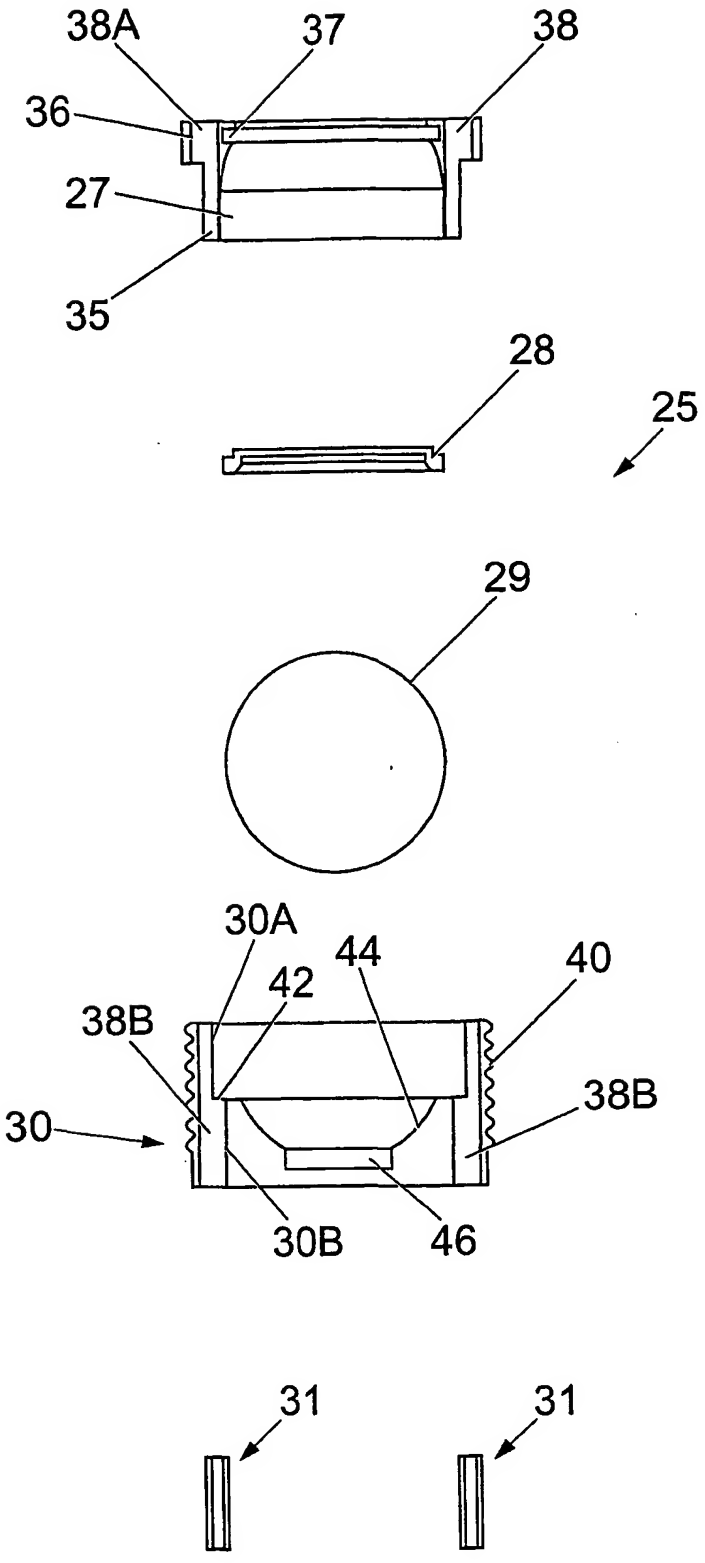

Fig. 5

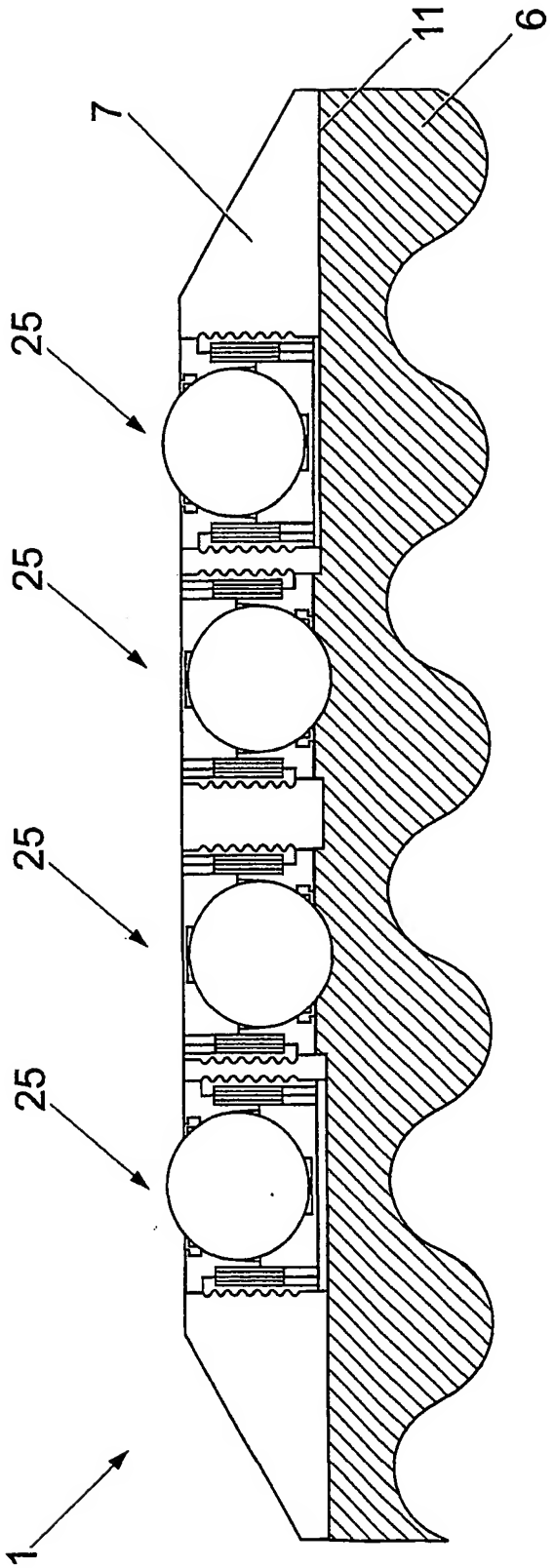

Fig. 6

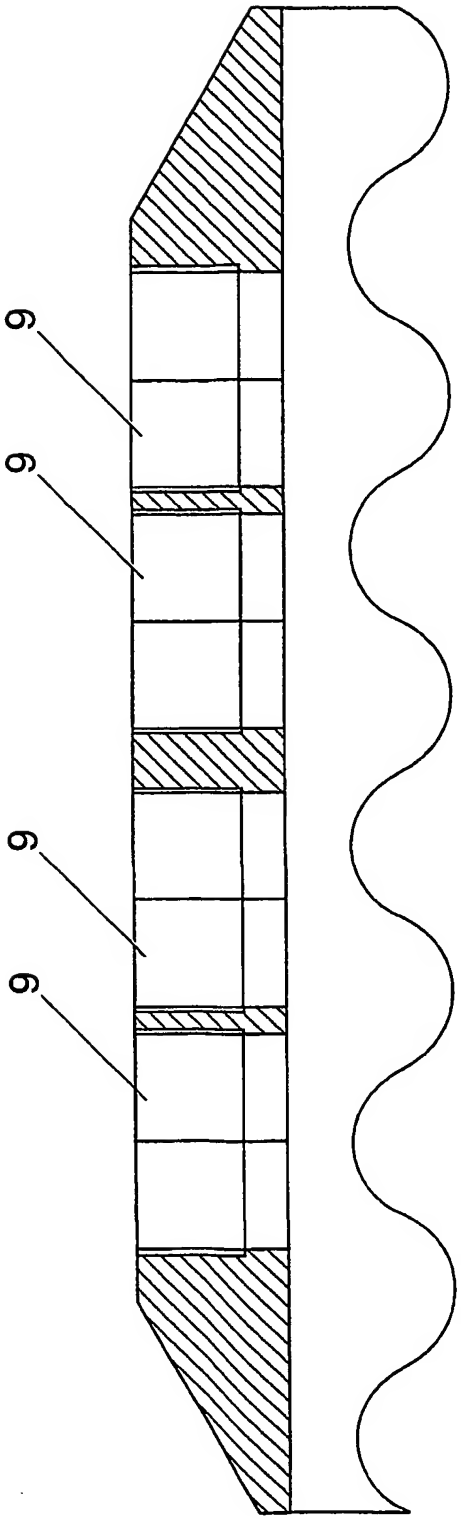

Fig. 7

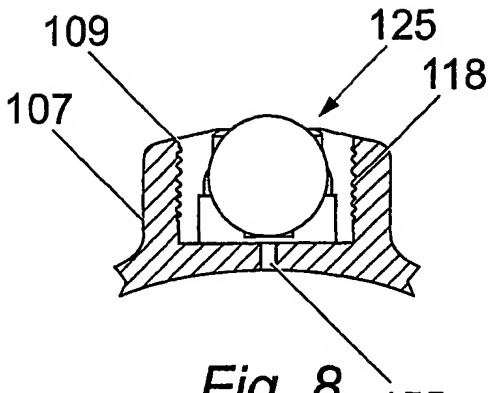

Fig. 8

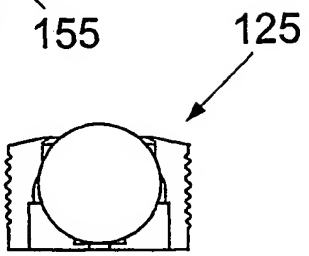

Fig. 9

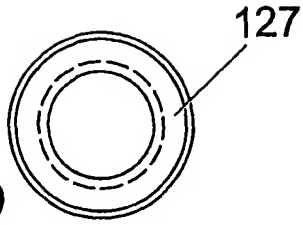

Fig. 10

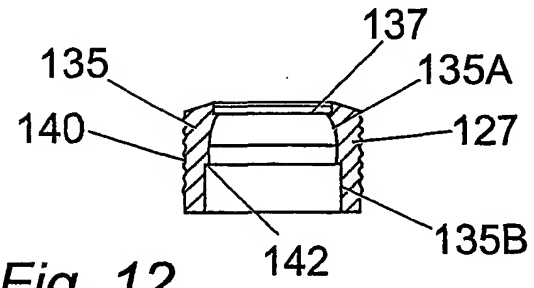

Fig. 12

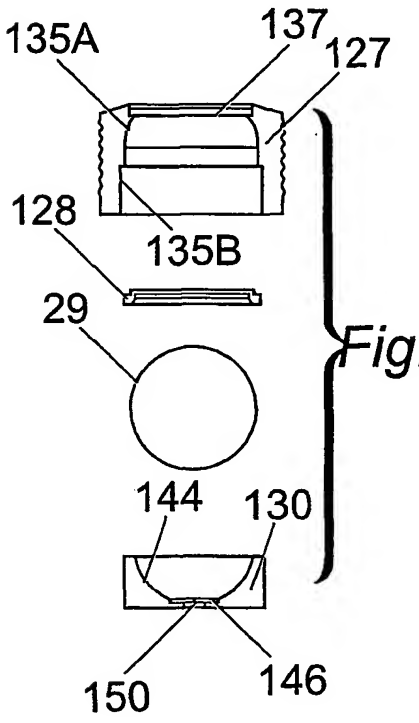

Fig. 11

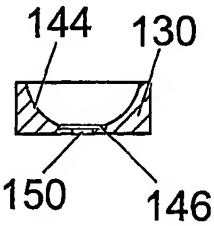

Fig. 13

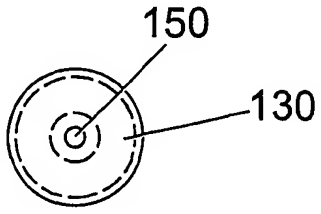

Fig. 14

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 333 450 A (ABERNETHY ANDERSON CHARLES) 20 September 1989 (1989-09-20) column 1, line 6 - line 8 column 1, line 55 -column 2, line 28; figures 2-4 ---	1-5,7,9, 10,12-18
X	US 1 699 087 A (WOODMANSEE HOLLIS D ET AL) 15 January 1929 (1929-01-15) figure 2 ---	1-4,6-8, 12
X	US 5 692 563 A (MOORE N BRUCE ET AL) 2 December 1997 (1997-12-02) column 3, line 6 - line 8 column 7, line 26 -column 8, line 2; figures 4,5 --- -/--	1-4,6,7, 12

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
14 September 2001	24/09/2001

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 23174 A (MARATHON OIL CO) 13 October 1994 (1994-10-13) figures 2,4,5	1-5,7,9, 10,12-18
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